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(54) **HYDRAULIC VALVE DEVICE**

HYDRAULISCHE VENTILVORRICHTUNG

SOUPAPE HYDRAULIQUE

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(73) Proprietor: **Nordhydraulic AB
872 24 Kramfors (SE)**

(72) Inventor: **ANDERSSON, Bo
S-554 48 Jönköping (SE)**

(74) Representative: **Holmberg, Nils Anders Patrik
BRANN AB
P.O. Box 12246
102 26 Stockholm (SE)**

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Description

TECHNICAL FIELD OF THE INVENTION

[0001] The invention relates to a hydraulic valve device and is described by way of examples with particular reference to its application on hydraulically driven and manoeuvred lifting booms, which are common in many mobile machines such as e.g. wheel-loaders and digging machines.

BACKGROUND

[0002] Many mobile machines include a lifting boom that may be swung up and down by means of a double acting hydraulic lift cylinder that acts between the lifting boom and frame work or base of the machine. This particular lift cylinder is included in a hydraulic system comprising a hydraulic pump and a control valve, by means of which the pump may be connected to the first lift cylinder chamber when the boom is to be elevated and to the second lift cylinder chamber when the boom is to be sunk. Simultaneously, in the first case the second lift cylinder chamber, and in the second case the first lift cylinder chamber is, via the control valve, connected to a tank for the hydraulic fluid.

[0003] An example can be found in WO2007/019712 A1.

[0004] Thus, in the most basic embodiment, the hydraulic valve device is such arranged that the pump fills the first lift cylinder chamber when the boom is to be elevated or sunk, such that the hydraulic fluid that is pressed out from the other lift cylinder chamber is released to the tank. Depending on if the boom is moved with or against the load, the pump will have to work much or less in order to achieve the necessary pressure for the operation. However, it must always deliver a sufficient flow to fill the emptying lift cylinder chamber in a pace that allows movement of the boom in the speed desired by the operator.

[0005] An unsatisfactory problem of an arrangement of the described type is that it makes the efficiency of the hydraulic system low at lowering of a load since the pump delivers pressure and flow even though the boom could be sunk by means of its own weight and load.

OBJECT OF THE INVENTION

[0006] The object of the present invention is to find a solution to these problems and provide a valve device that saves a substantial part of the energy that is lost at lowering of a load with conventional hydraulic load control valves of the type described above.

[0007] This is achieved in accordance with a first aspect of the invention by means of a hydraulic valve device comprising a first motor port and a second motor port to a double acting hydraulic motor, in particular a double acting hydraulic cylinder; a tank and a pump; a control

valve which is arranged such that it connects the motor ports to the tank and the pump, and which control valve has two open positions, wherein it in the first open position, via a line connects the pump to the first motor port and the tank to the second motor port, and in the second open position via a line connects the pump to the second motor port and the tank to the first motor port; a first non-return valve, which is arranged between the pump and the second motor port and opens towards the second motor port. Additionally, a piston, which via a line and by means of the load pressure in the first motor port governs the first nonreturn valve, such that this is kept closed as long as the pump pressure does not exceed said load pressure; and a second nonreturn valve, which is arranged such that it, when the control valve is in its first open position, connects the first motor port to the second motor port and opens towards the second motor port.

[0008] Due to this valve device the hydraulic fluid from the first motor port will, when the pressure at it is sufficiently high, refill the second motor port, such that the pump does not have to work in order to lower a load.

[0009] In advantageous embodiments of the invention the valve device is arranged such that refilling may be achieved in both directions, which is advantageous for machines where the load may act in two directions.

[0010] The invention is described in detail below, with reference to the accompanying drawings.

SHORT DESCRIPTION OF THE DRAWINGS

[0011]

Fig. 1 shows a vehicle with a hydraulically manoeuvred boom and a hydraulic system with a double acting hydraulic lift cylinder and a conventional valve device mounted thereon;

Fig. 2 is a hydraulic diagram for the lift cylinder in fig. 1, provided with a conventional valve device;

Fig. 3 is a hydraulic diagram resembling the one in fig. 2, but showing a valve device in accordance with a first embodiment of the invention;

Fig. 4 is a hydraulic diagram showing a valve device in accordance with a second embodiment of the invention;

Fig. 5 is a hydraulic diagram showing a valve device in accordance with a third embodiment of the invention; and

Fig. 6 is a hydraulic diagram showing a valve device in accordance with a fourth embodiment of the invention.

DETAILED DESCRIPTION OF THE FIGURES

[0012] The hydraulically manoeuvred lifting boom shown in fig. 1 is adapted to be arranged on a vehicle (not shown) and has a base A with a rotatable crane B, which carries the boom arm C at its upper end. A double acting hydraulic motor, in form of a hydraulic lift cylinder D is arranged between the boom arm C and the foot of the crane B of the base. Lines F and G connect the two lift cylinder chambers to a control valve H, which in the shown example is lever controlled and in turn is connected to a hydraulic pump and a tank T via additional lines J and K, respectively.

[0013] In fig. 2, a part of the hydraulic system of the machine, which is useful to manoeuvre the lift cylinder D, is shown. The first, lower, chamber of the lift cylinder (the lifting chamber), has a first motor port, hereafter called the lower lift cylinder port L, as the lift cylinder D constitutes the motor. The line F connects the lift cylinder port to a first feed connection port or operational port M on the control valve H, which in the shown example is of an open centre type. The second, upper chamber of the lift cylinder (the release chamber) correspondingly has a second motor port, called upper lift cylinder port N, which is connected to a second operational port O on the control valve H, via the line G. When the control valve is in the position shown in the figure, the pump flow flows through the centre line of the control valve to the line K and on to the tank T.

[0014] The fluid flows through the valve back to the tank with a very low pump pressure why very little energy is consumed. However, as long as the motor is running it is common procedure to let the pump work and it is thus not expected to turn off the pump I just because there is no instantaneous need to change the position of the boom.

[0015] As soon as the control valve is manoeuvred in any direction, the centre line will be partly closed and the pump I will be connected to one of the chambers of the lift cylinder, whereby the second chamber of the lift cylinder to a correspondingly degree will be connected to the tank T. If the pressure delivered by the pump is sufficiently high, a certain flow will flow through the control valve to the connected lift cylinder chamber at the same time as the other lift cylinder chamber to a correspondingly degree is emptied to the tank T, whereby the boom will be moved.

[0016] When the boom C is raised (raising of a positive load) the control valve H directs the hydraulic fluid under high pressure from the pump through the first operational port M and the line F to the lower chamber of the lift cylinder D. Since the pump pressure must act against the load in this instance in order to open the nonreturn valve 1, the pump pressure must be controlled to a relatively high level, i.e. sufficiently high so that the pressure in the line J exceeds the pressure in the lower chamber of the lift cylinder D and thus the line F, before the pump flow will fill the lower chamber of the lift cylinder D. Thus,

on manoeuvring of the control valve H, the opening of the centre line is reduced, whereby the pump pressure increases. At the same time the valve opens from the feed connection port M to the lower cylinder port L and from the upper cylinder port N to the tank connection O of the valve. When the valve is manoeuvred such that the pump pressure exceeds the pressure in the cylinder port, the nonreturn valve 1 opens and a flow from the pump to the cylinder is released. Upon further manoeuvring of the valve the flow through the valve to the cylinder increases. Hydraulic fluid will at the same time under low pressure flow through the line G and the control valve H to the tank T.

[0017] The nonreturn valve 1 in the feed line J of the valve H prevents flow "in the wrong direction", opposite the pump flow, upon activation of the valve and when the pump pressure is lower than the pressure in the port of the cylinder, which otherwise would constitute a great danger.

[0018] When the boom C is lowered (lowering of a positive load) the hydraulic fluid from the pump is directed through the second operational port O of the control valve H to the upper chamber in the lift cylinder D, and the hydraulic fluid from the lower lift cylinder chamber is directed to the tank T.

[0019] On command the valve between the lower cylinder port L and the tank T opens, resulting in that the cylinder is moved downwards in the figure. Simultaneously the centre line is closed and the pump pressure increases, wherein a flow from the pump to the suction side of the cylinder, i.e. the upper cylinder port N, is provided. The pump flow at a lowering movement involves a loss of energy, which is a disadvantage of this system.

[0020] An automatic restriction of the energy loss created in the system in figure 2 may be achieved by means of an automatic low pressure regeneration in accordance with the invention. The valve device according to the invention represents a substantial improvement with respect to the efficiency loss compared to the prior art, as represented in fig. 1 and 2. Four exemplifying embodiments of the invention are shown in fig. 3, 4, 5 and 6.

[0021] The representation of the diagram of figure 3 differs from figure 2 in that the nonreturn valve 1A is complemented with a piston 2, which is governed by the load pressure in the lower lift cylinder port L. Further, a nonreturn valve 3 is arranged and connects the centre line and the line K leading to the tank T to the upper lift cylinder port N. The nonreturn valve 3 opens towards the upper lift cylinder port N and closes towards the centre line. Additionally, on the line K, a back-pressure valve or a pre-stressed nonreturn valve 4 may be arranged to open towards the tank T, at a certain pressure. The nonreturn valve 4 is mainly intended to create a certain resistance for the hydraulic fluid towards the tank T, but as there often exits a certain inherent resistance in the lines towards the tank, this nonreturn valve 4 is not always needed.

[0022] At lowering of the cylinder piston, the valve is

manoeuvred such that a flow from the lower lift cylinder port L, which is subjected to a load, to the tank is obtained, which results in a sinking movement of the cylinder piston. At the same time, the pump flow is prevented from flowing to the suction side of the cylinder, i.e. the upper lift cylinder port N due to that the load pressure at the lower lift cylinder port L via the piston 2 keeps the nonreturn valve 1A in a closed position. Instead, the suction side of the cylinder is refilled via the nonreturn valve 3, which redirects the flow from the pressure side of the cylinder, i.e. the lower lift cylinder port L, to its suction side, via the tank line G. The back-pressure valve 4 in the tank line makes sure that the outlet flow from the pressure side of the cylinder in the first event flows to the suction side of the cylinder. However, since the lower cylinder has a greater volume than the upper cylinder a certain flow flows through the back-pressure valve 4 to the tank T.

[0023] The back-pressure valve 4 may be adapted for a low pressure e.g. 3 Bar, which does not provide an efficiency loss of importance upon raising of a load.

[0024] If the load, turns into a lifting load while the cylinder piston is being lowered, such that the upper chamber and hence the port N of the lift cylinder becomes put under pressure, the pressure acting on the piston 2 will cease, whereupon the nonreturn valve 1A automatically will open such that the pump may direct the pump flow to the port N of the upper cylinder chamber. Thus, the upper cylinder chamber may be filled regardless of if the load that acts on the cylinder is positive or negative, but when the load is positive the piston 2 will keep the nonreturn valve 1A closed, such that the upper cylinder chamber is filled solely with hydraulic fluid from the port L of the lower lift cylinder chamber, which is under pressure. This method is in this application referred to as automatic low pressure regeneration.

[0025] If the cylinder is arranged such that it may be exerted to both pressing and tensioning pressure load, the automatic low pressure regeneration may be useful in both directions. Such a valve device is shown in figure 4. In this second embodiment of the invention, the device is complemented by a nonreturn valve 5 from the tank line K to the lower cylinder port L and by a reverse valve 7 that directs the highest cylinder port pressure to the piston 2 of the nonreturn valve 1A.

[0026] When the cylinder piston is raised, the flow out from the upper cylinder port N is, due to the ratio between the different cross sections of the cylinder, less than what is needed to fill up the upper lift cylinder port L. However, a pressure reducing valve 6 adjusted for a lower pressure than the back-pressure valve 4, is arranged to open when the pressure in the tank line K goes below a certain pressure such that the pump flow may flow through the same and guarantee some pressure in the tank line K, such that cavitation on the suction side of the cylinder is avoided. The pressure reducing valve 6 is arranged to open at a lower pressure than the back-pressure valve 4, such that it does not open when there exists a flow to the tank T.

[0027] If it is desired to raise a negative load, i.e. to move the piston rod in the direction of a load acting upwards, the control valve H may be manoeuvred to a first open position, at which the outlets of the pump I and the nonreturn valve 1A are connected to the first operational port M and hence to the lower lift cylinder port L. Simultaneously, the upper lift cylinder port N will become connected to the tank line K, via the second operational port O, and since the upper cylinder is on load the hydraulic fluid flowing out from the upper lift cylinder port N has a high pressure, such that the pressure reducing valve 6 is initially kept close. Additionally, the same pressure will be transmitted from the reverse valve 7 via the line E to the piston 2 of the nonreturn valve 1A, such that this is kept closed. Due to the low pressure at the negatively loaded lower lift cylinder port L the flow from the upper cylinder port N will flow through the nonreturn valve 5 to said lower lift cylinder port L. Since the centre line of the control valve is throttled the more it is moved towards the first open position the pressure will decrease in the line K, as a consequence of that the hydraulic fluid from the upper cylinder port N is not enough to fill the lower cylinder, whereby the pressure reducing valve 6 opens, such that the pump flow may flow under a very low pressure to the line K and on through the nonreturn valve 5 to the lower the cylinder L, wherein cavitation in it is avoided in a most energy saving manner.

[0028] If, on the contrary and in a corresponding manner, it is desired to sink a positive load, i.e. to move the piston rod in the direction of a load acting downwards the control valve H may be manoeuvred to a second open position, in which the outlets of the pump I and the nonreturn valves 1A is connected to the second operational port O. and hence to the upper lift cylinder port N. Simultaneously, the lower lift cylinder port L will be connected to the tank line K, via the second operational port M, and since the lower cylinder is on load the hydraulic fluid flows out from it under high pressure, whereby the pressure reducing valve 6 will be kept closed. Additionally, the same pressure will be transmitted from the reverse valve 7 to the piston 2 of the nonreturn valve 1A, via the line E, such that this is kept closed. The pump flow will thus flow through the open centre of the control valve H to the line K under a low pressure. Due to the low pressure at the negatively loaded lower lift cylinder port L, the flow will in the first instance flow through the nonreturn valve 5 to said lift cylinder port L, wherein the surplus flows via the nonreturn valve 4 to the tank T.

[0029] Figure 5, shows a valve device resembling the valve device in figure 3, but in which the nonreturn valve with a piston is placed closer to the cylinder. The function of the valve device in figure 5 is the same as for the valve device in figure 3. A reason for arranging two different embodiments having the same functions is that they may present alternative for different existing hydraulic systems and that one may be advantageous in certain systems, while the other is better suited for other types of systems. This choice is mainly dependent on whether it

is desired to keep the components, such as valves and similar, gathered close to the lift cylinder or not.

[0030] In order to replace the function of the nonreturn valve 1A with a piston shown in figure 3, two additional nonreturn valves 8 and 9 are needed to achieve the same function, and a nonreturn valve 1, which corresponds to the nonreturn valve 1A in figure 3 and 4 without piston, is arranged to prevent flow opposite to the pump flow. The nonreturn valve 8, which by means of the piston 2 is governed by the pressure in the lower cylinder port L, takes the part of all the parts of the nonreturn valve 1A in figure 3, when the feed connection M is connected to the upper cylinder port N to fill the same. If a load acts downwards on the cylinder, this nonreturn valve 8 will be kept closed, as result of to the load pressure towards the piston 2. Thus, the pump flow will flow under low pressure back to the tank T, while the hydraulic fluid that is allowed to leave the lower cylinder port L towards valve port M and the line K will refill the upper cylinder chamber via the nonreturn valve 3. The anti parallel nonreturn valve 9 is necessary in order to allow the upper cylinder chamber to empty to the tank.

[0031] In correspondence with the embodiment shown in figure 3 the embodiment shown in figure 5 only offers automatic low pressure regeneration in one direction. Therefore, in figure 6 an embodiment that resembles the embodiment shown in figure 5, but which in correspondence to the embodiment of figure 4 offers automatic low pressure regeneration in two directions, is shown.

[0032] In the diagram of figure 6, two pistons 2 and 10, and in connection to these, four nonreturn valves 8, 9 and 11, 12, are arranged, two for each piston. The piston 2 and the nonreturn valves 8 and 9 are arranged exactly in the same manner as in figure 5, while the piston 2 and the nonreturn valves 11 and 12 are arranged in a corresponding manner, except that they control the flow to and from the lower cylinder chamber L instead of the upper.

[0033] Thus, when a negative load is exerted on the cylinder, i.e. when the piston rod is being loaded from below in the figure, the pressure from the load will, by means of the piston 10, keep the nonreturn valve 11 closed, such that the pump flow instead chooses the path through the centre line of the control valve H, via the nonreturn valve 4, to the tank T. The lower cylinder chamber will then be filled primarily with return flow from the upper cylinder chamber, which flows via the nonreturn valve 9 through the control valve H to the tank line K, where it is added to the pump flow. Since the nonreturn valve 4 is lightly pre-stressed the flow will primarily be lead through the nonreturn valve 5 to the lower lift cylinder port L.

[0034] As mentioned above, the flow from the upper lift cylinder port N is not enough, due to ratio of the sectional areas, to fill the lower cylinder chamber, but since the flow from the upper cylinder chamber is completed with the pump flow, there is no risk for cavitation in the lower cylinder chamber. Thus, on movement in direction with a negative load, the pump has to deliver a certain

flow in order to avoid cavitation, as opposed to when the cylinder piston is moved in direction with a positive load where the return flow from the lower lift cylinder port L is sufficient to alone fill the upper cylinder chamber N.

[0035] The invention has been described with reference to four embodiments with the same particular application. However, it is obvious to a person skilled in the art that various embodiments and applications are feasible for the invention, the scope of which is only limited by the following claims.

Claims

1. Hydraulic valve device comprising:

- a first motor port (L) and a second motor port (N) to a double acting hydraulic motor (D), in particular a double acting hydraulic cylinder,
- a tank (T), and a pump (I),
- a control valve (H), which is arranged such that it connects the motor ports (L, N) to the tank (T) and the pump (I), and which control valve (H) has two open positions, wherein the pump (I) in the first open position via a first line (F) is connected to the first motor port (L) and the tank (T) via a second line (G) is connected to the second motor port (N), and wherein the pump (I) in the second open position via said second line (G) is connected to the second motor port (N) and the tank (T) via said first line (F) is connected to the first motor port (L), and
- a first nonreturn valve (1A, 8), which is arranged between the pump (I) and the second motor port (N) and opens towards the second motor port (N), **characterised in**
- a piston (2), which by means of the load pressure in the first motor port (L) via a third line (E) governs the first nonreturn valve (1A, 8), such that it is kept closed as long as the pump pressure does not exceed said load pressure, and
- a second nonreturn valve (3), which is arranged such that it, as long as the control valve (H) is in its second open position, connects the first motor port (L) to the second motor port (N) and opens in direction towards the second motor port (N).

2. Valve device according to claim 1, **characterised in** a back-pressure valve (4), which is arranged on a fourth line (K) towards the tank (T) to create a certain resistance in said fourth line (K) towards the tank (T).

3. Valve device according to claim 2, **characterised in that** the first nonreturn valve (1A) is arranged between the pump (I) and the control valve (H) and opens towards the control valve (H).

4. Valve device according to claim 3, **characterised in that** the control valve (H) has an open centre, which opens towards said fourth line (K) to the tank (T), wherein the pump flow when the control valve is in a neutral position is lead via said fourth line (K) to the tank (T). 5
5. Valve device according to claim 4, **characterised in that** the second nonreturn valve (3) is arranged such that, it connects said fourth line (K) to said second line (G) and opens towards said second line (G) the hydraulic fluid from the second motor port (N) in the first open position of the control valve (H) being lead through the control valve to said fourth line (K).
6. Valve device according to claim 5, **characterised in**
- a third nonreturn valve (5) that connects said fourth line (K) to said third line (F) and opens towards said third line (F), 20
 - a pressure reducing valve (6) that opens from a fifth line (J) towards said fourth line (K) when the pressure in the tank line (K) is below a certain pressure that is lower than the pressure required to open the back-pressure valve (4), 25
 - a reverse valve (7) that transmits the highest cylinder port pressure to the piston (2) of the nonreturn valve (1A), such that the nonreturn valve (1A) is kept closed as long as the pump pressure does not exceed said highest cylinder port pressure. 30
7. Valve device according to claim 1 or 2, **characterised in that** the first nonreturn valve (8) is arranged on said second line (G) between the control valve (H) and the second motor port (N) and opens towards the second motor port (N), and a nonreturn valve (9) that is anti parallel to the first nonreturn valve (8) is arranged on said same second line (G). 35
8. Valve device according to claim 7, **characterised in**
- a third nonreturn valve (5) that connects said fourth line (K) to said third line (F) and opens towards said third line (F), 40
 - a fourth nonreturn valve (11) that is arranged on said third line (F) between the control valve (H) and the first motor port (L) and opens towards the first motor port (L), wherein a nonreturn valve (12) that is anti parallel to the fourth nonreturn valve (11) is arranged on said same third line (F), and 45
 - a second piston (10), which via a sixth line (Z) by means of the load pressure in the second motor port (N) controls the fourth nonreturn valve (11), such that this is kept closed as long as the pump pressure does not exceed said load pressure. 50

9. Valve device according to claim 7 or 8, **characterised in a fifth nonreturn valve (1) arranged between the pump (I) and the control valve (H), which opens towards the control valve (H), to prevent flow opposite to the pump flow.**

Patentansprüche

1. Hydraulische Ventilvorrichtung mit:
- einem ersten Motoranschluss (L) und einem zweiten Motoranschluss (N) zu einem doppeltwirkenden Hydraulikmotor (D), insbesondere einem doppeltwirkenden Hydraulikzylinder,
 - einem Tank (T) und einer Pumpe (I),
 - einem Steuerventil (H), das so angeordnet ist, dass es die Motoranschlüsse (L, N) mit dem Tank (T) und der Pumpe (I) verbindet und das Steuerventil (H) zwei Öffnungsstellungen hat, wobei die Pumpe (I) in der ersten Öffnungsstellung über eine erste Leitung (F) mit dem ersten Motoranschluss (L) verbunden ist und der Tank (T) über eine zweite Leitung (G) mit dem zweiten Motoranschluss (N) verbunden ist und wobei die Pumpe (I) in der zweiten Öffnungsstellung über die zweite Leitung (G) mit dem zweiten Motoranschluss (N) verbunden ist und der Tank (T) über die erste Leitung (F) mit dem ersten Motoranschluss (L) verbunden ist, und
 - einem ersten Rückschlagventil (1A, 8), das zwischen der Pumpe (I) und dem zweiten Motoranschluss (N) angeordnet ist und sich in Richtung des zweiten Motoranschlusses (N) öffnet, **gekennzeichnet durch**
 - einen Kolben (2), der mittels eines Lastdrucks in dem ersten Motoranschluss (L) über eine dritte Leitung (E) das erste Rückschlagventil (1A, 8) regelt, sodass es geschlossen gehalten wird, solange der Pumpendruck nicht den Lastdruck überschreitet, und
 - ein zweites Rückschlagventil (3), das so angeordnet ist, dass es den ersten Motoranschluss (L) mit dem zweiten Motoranschluss (N) verbindet und sich in Richtung des zweiten Motoranschlusses (N) öffnet, solange das Steuerventil (H) in seiner zweiten Öffnungsstellung ist.
2. Ventilvorrichtung gemäß Anspruch 1, **gekennzeichnet durch** ein Überdruckventil (4), das auf einer vierten Leitung (K) in Richtung des Tanks (T) angeordnet ist, um einen festgelegten Widerstand in der vierten Leitung (K) in Richtung des Tanks (T) zu erzeugen.
3. Ventilvorrichtung gemäß Anspruch 2, **dadurch gekennzeichnet, dass** das erste Rückschlagventil (1A) zwischen der Pumpe (I) und dem Steuerventil

(H) angeordnet ist und sich in Richtung des Steuerventils (H) öffnet.

4. Ventilvorrichtung gemäß Anspruch 3, **dadurch gekennzeichnet, dass** das Steuerventil (H) einen offenen Mittelpunkt aufweist, der sich in Richtung der vierten Leitung (K) zu dem Tank (T) öffnet, wobei der Förderstrom über die vierte Leitung (K) zu dem Tank (P) geleitet wird, wenn das Steuerventil in einer neutralen Stellung ist. 5
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5. Ventilvorrichtung gemäß Anspruch 4, **dadurch gekennzeichnet, dass** das zweite Rückschlagventil (3) so angeordnet ist, dass es die vierte Leitung (K) mit der zweiten Leitung (G) verbindet und sich in Richtung der zweiten Leitung (G) öffnet, wobei das Hydraulikfluid in der ersten Öffnungsstellung des Steuerventils (H) von dem zweiten Motoranschluss (N) durch das Steuerventil zu der vierten Leitung (K) geführt wird. 15
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6. Ventilvorrichtung gemäß Anspruch 5, **gekennzeichnet durch**
 - ein drittes Rückschlagventil (5), das die vierte Leitung (K) mit der dritten Leitung (F) verbindet und sich in Richtung der dritten Leitung (F) öffnet, 25
 - ein Druckreduzierventil (6), das sich von einer fünften Leitung (J) in Richtung der vierten Leitung (K) öffnet, wenn der Druck in der Tankleitung (K) unter einem festgelegten Druck liegt, der niedriger ist als der Druck, der zum Öffnen des Überdruckventils (4) benötigt wird, 30
 - ein Umschaltventil (7), das den höchsten Zylinderanschlussdruck zu dem Kolben (2) des Rückschlagventils (1A) überträgt, sodass das Rückschlagventil (1A) solange geschlossen gehalten wird, wie der Pumpendruck nicht den höchsten Zylinderanschlussdruck übersteigt. 35
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7. Ventilvorrichtung gemäß Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** das erste Rückschlagventil (8) an der zweiten Leitung (G) zwischen dem Steuerventil (H) und dem zweiten Motoranschluss (N) angeordnet ist und sich in Richtung des zweiten Motoranschlusses (N) öffnet und dadurch, dass ein Rückschlagventil (9), das antiparallel zu dem ersten Rückschlagventil (8) ist, an derselben zweiten Leitung (G) angeordnet ist. 45
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8. Ventilvorrichtung gemäß Anspruch 7, **gekennzeichnet durch**
 - ein drittes Rückschlagventil (5), das die vierte Leitung (K) mit der dritten Leitung (F) verbindet und sich in Richtung der dritten Leitung (F) öffnet, 55

- ein viertes Rückschlagventil (11), das an der dritten Leitung (F) zwischen dem Steuerventil (H) und dem ersten Motoranschluss (L) angeordnet ist und sich in Richtung des ersten Motoranschlusses (L) öffnet, wobei ein Rückschlagventil (12), das antiparallel zu dem vierten Rückschlagventil (11) ist, an derselben dritten Leitung (F) angeordnet ist, und
- einen zweiten Kolben (10), der das vierte Rückschlagventil (11) über eine sechste Leitung (Z) mittels des Lastdrucks in dem zweiten Motoranschluss (N) steuert, so dass es geschlossen gehalten wird, solange der Pumpendruck den Lastdruck nicht überschreitet.

9. Ventilvorrichtung gemäß Anspruch 7 oder 8, gekennzeichnet durch ein fünftes Rückschlagventil (1), das zwischen der Pumpe (I) und dem Steuerventil (H) angeordnet ist und sich in Richtung des Steuerventils (H) öffnet, um einem dem Förderstrom entgegengesetzten Strom vorzubeugen.

Revendications

1. Dispositif de soupape hydraulique comprenant :

- un premier orifice de moteur (L) et un second orifice de moteur (N) sur un moteur hydraulique à double effet (D), en particulier un vérin hydraulique à double effet,
- un réservoir (T), et une pompe (I),
- une soupape de commande (H), qui est agencée de manière à relier les orifices de moteur (L, N) au réservoir (T) et à la pompe (I), et laquelle soupape de commande (H) a deux positions ouvertes, la pompe (I) dans la première position ouverte, via une première conduite (F), étant reliée au premier orifice de moteur (L) et le réservoir (T), via une deuxième conduite (G), étant relié au second orifice de moteur (N), et la pompe (I) dans la seconde position ouverte via ladite deuxième conduite (G), étant reliée au second orifice de moteur (N) et le réservoir (T) via ladite première conduite (F), étant relié au premier orifice de moteur (L), et
- une première soupape de non-retour (1A, 8) qui est disposée entre la pompe (I) et le second orifice de moteur (N) et s'ouvre vers le second orifice de moteur (N), **caractérisé par** :
- un piston (2) qui, au moyen de la pression de charge dans le premier orifice de moteur (L), via une troisième conduite (E), commande la première soupape de non-retour (1A, 8), de manière qu'elle soit gardée fermée tant que la pression de la pompe n'excède pas ladite pression de charge, et
- une deuxième soupape de non-retour (3), qui

est disposée de manière à relier, tant que la soupape de commande (H) se trouve dans sa seconde position ouverte, le premier orifice de moteur (L) au second orifice de moteur (N) et s'ouvre dans une direction vers le second orifice de moteur (N).

2. Dispositif de soupape selon la revendication 1, **caractérisé par** une soupape de contre-pression (4) qui est disposée sur une quatrième conduite (K) vers le réservoir (T) pour créer une certaine résistance dans ladite quatrième conduite (K) vers le réservoir (T).
3. Dispositif de soupape selon la revendication 2, **caractérisé en ce que** la première soupape de non-retour (1A) est disposée entre la pompe (I) et la soupape de commande (H) et s'ouvre vers la soupape de commande (H).
4. Dispositif de soupape selon la revendication 3, **caractérisé en ce que** la soupape de commande (H) présente un centre ouvert, qui s'ouvre vers ladite quatrième conduite (K) sur le réservoir (T), l'écoulement de la pompe lorsque la soupape de commande se trouve dans une position neutre étant conduit, via ladite quatrième conduite (K), jusqu'au réservoir (T).
5. Dispositif de soupape selon la revendication 4, **caractérisé en ce que** la deuxième soupape de non-retour (3) est agencée de manière à relier ladite quatrième conduite (K) à ladite seconde conduite (G) et s'ouvre vers ladite seconde conduite (G), le fluide hydraulique provenant du second orifice de moteur (N) dans la première position ouverte de la soupape de commande (H) étant conduit via la soupape de commande jusqu'à ladite quatrième conduite (K).
6. Dispositif de soupape selon la revendication 5, **caractérisé par** :
 - une troisième soupape de commande (5) qui relie ladite quatrième conduite (K) à ladite troisième conduite (F) et s'ouvre vers ladite troisième conduite (F),
 - une soupape de réduction de pression (6) qui s'ouvre depuis une cinquième conduite (J) vers ladite quatrième conduite (K) lorsque la pression dans la conduite de réservoir (K) est inférieure à une certaine pression qui est inférieure à la pression requise pour ouvrir la soupape de contre-pression (4),
 - une soupape d'inversion (7) qui transmet la pression d'orifice de cylindre la plus élevée au piston (2) de la soupape de non-retour (1A), de manière que la soupape de non-retour (1A) soit maintenue fermée tant que la pression de la pompe n'excède pas ladite pression d'orifice de

cylindre la plus élevée.

7. Dispositif de soupape selon la revendication 1 ou 2, **caractérisé en ce que** la première soupape de non-retour (8) est disposée sur ladite deuxième conduite (G) entre la soupape de commande (H) et le second orifice de moteur (N) et s'ouvre vers le second orifice de moteur (N), et une soupape de non-retour (9) qui est antiparallèle à la première soupape de non-retour (8) est disposée sur ladite même seconde conduite (G).
8. Dispositif de soupape selon la revendication 7, **caractérisé par** :
 - une troisième soupape de non-retour (5) qui relie ladite quatrième conduite (K) à ladite troisième conduite (F) et s'ouvre vers ladite troisième conduite (F),
 - une quatrième soupape de non-retour (11) qui est disposée sur ladite troisième conduite (F) entre la soupape de commande (H) et le premier orifice de moteur (L) et s'ouvre vers le premier orifice de moteur (L), une soupape de non-retour (12) qui est antiparallèle à la quatrième soupape de non-retour (11) étant agencée sur ladite même troisième conduite (F), et
 - un second piston (10), qui, via une sixième conduite (Z) au moyen de la pression de charge dans le second orifice de moteur (N), commande la quatrième soupape de non-retour (11), de manière qu'elle soit gardée fermée tant que la pression de la pompe n'excède pas ladite pression de charge.
9. Dispositif de soupape selon la revendication 7 ou 8, **caractérisé par** :
 - une cinquième soupape de non-retour (1) disposée entre la pompe (I) et la soupape de commande (H), qui s'ouvre vers la soupape de commande (H), pour empêcher un écoulement opposé à l'écoulement de la pompe.

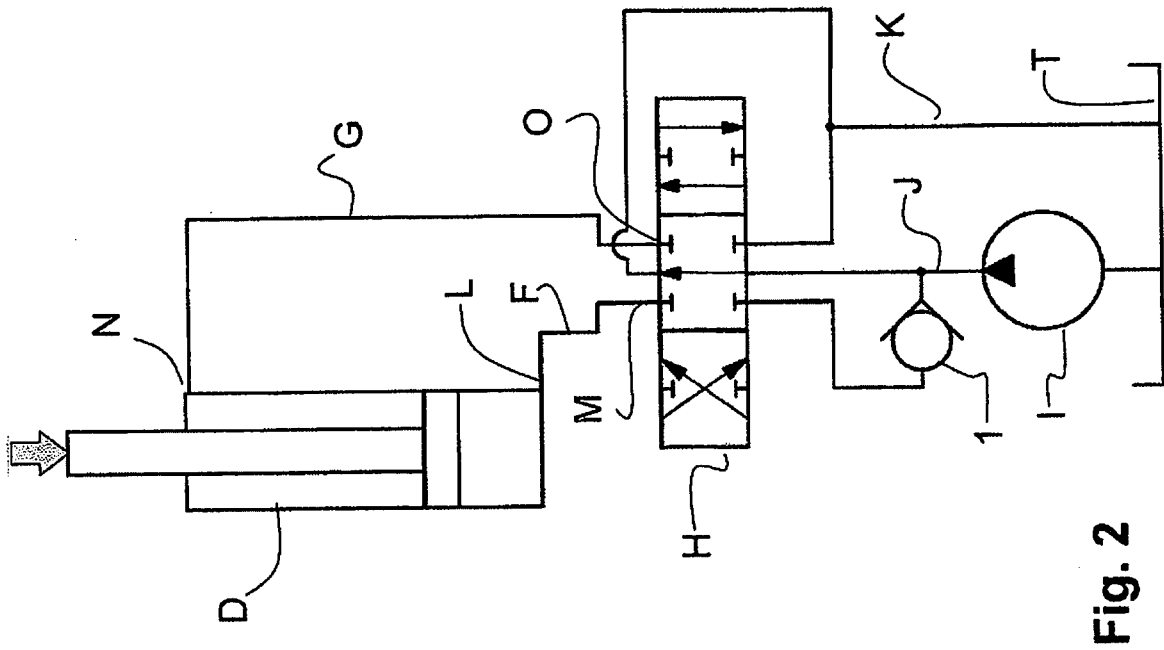


Fig. 1

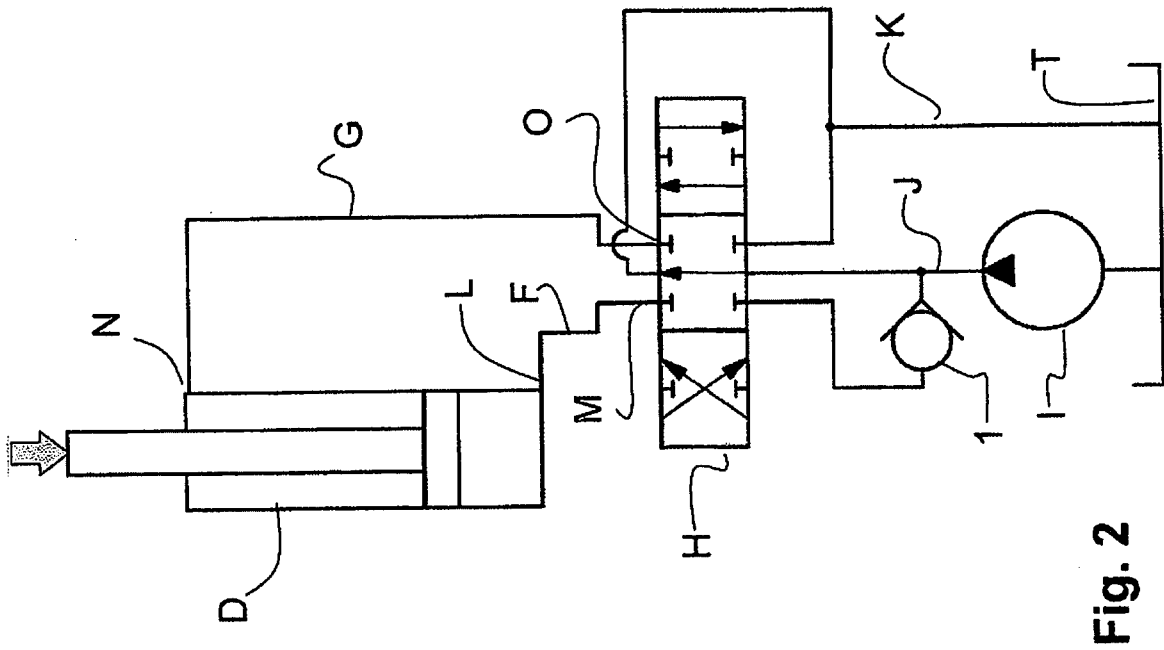
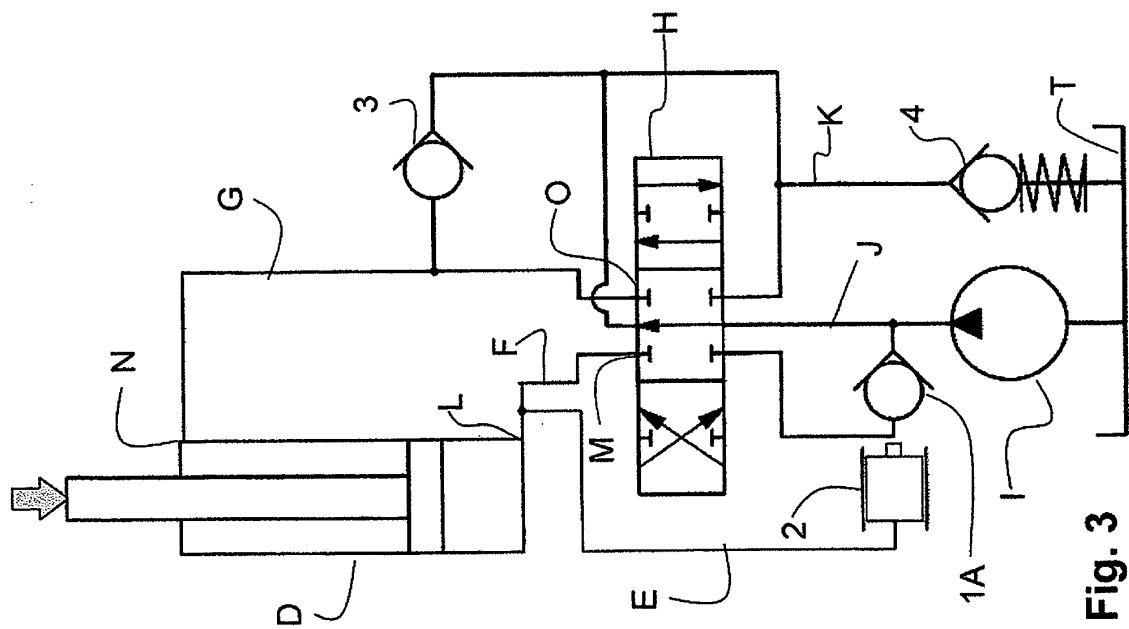
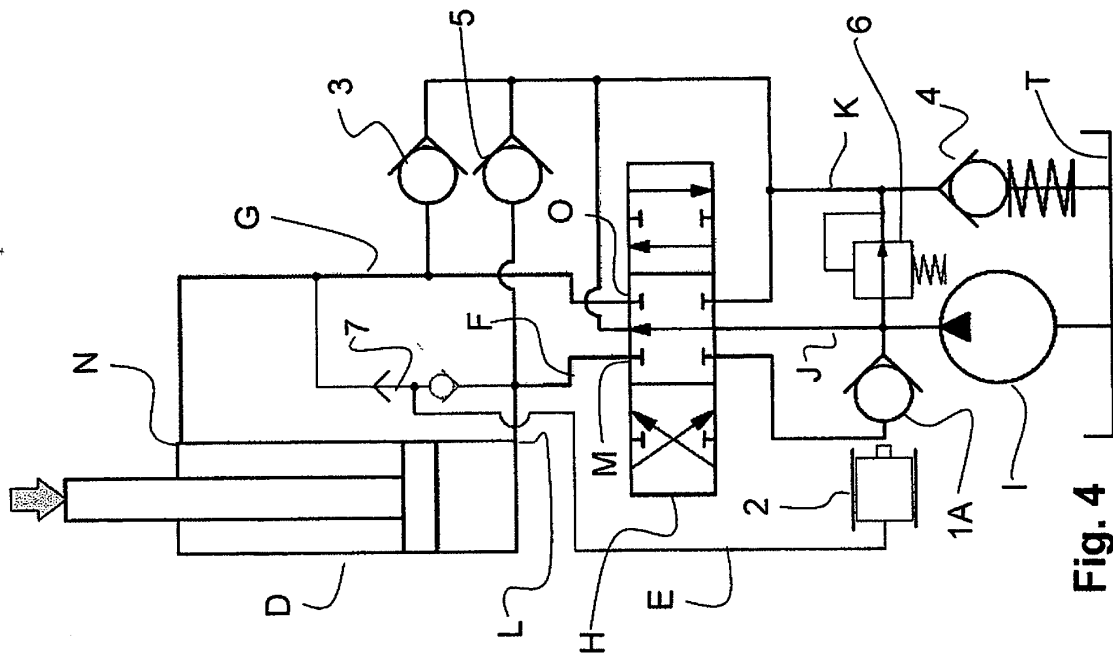


Fig. 2



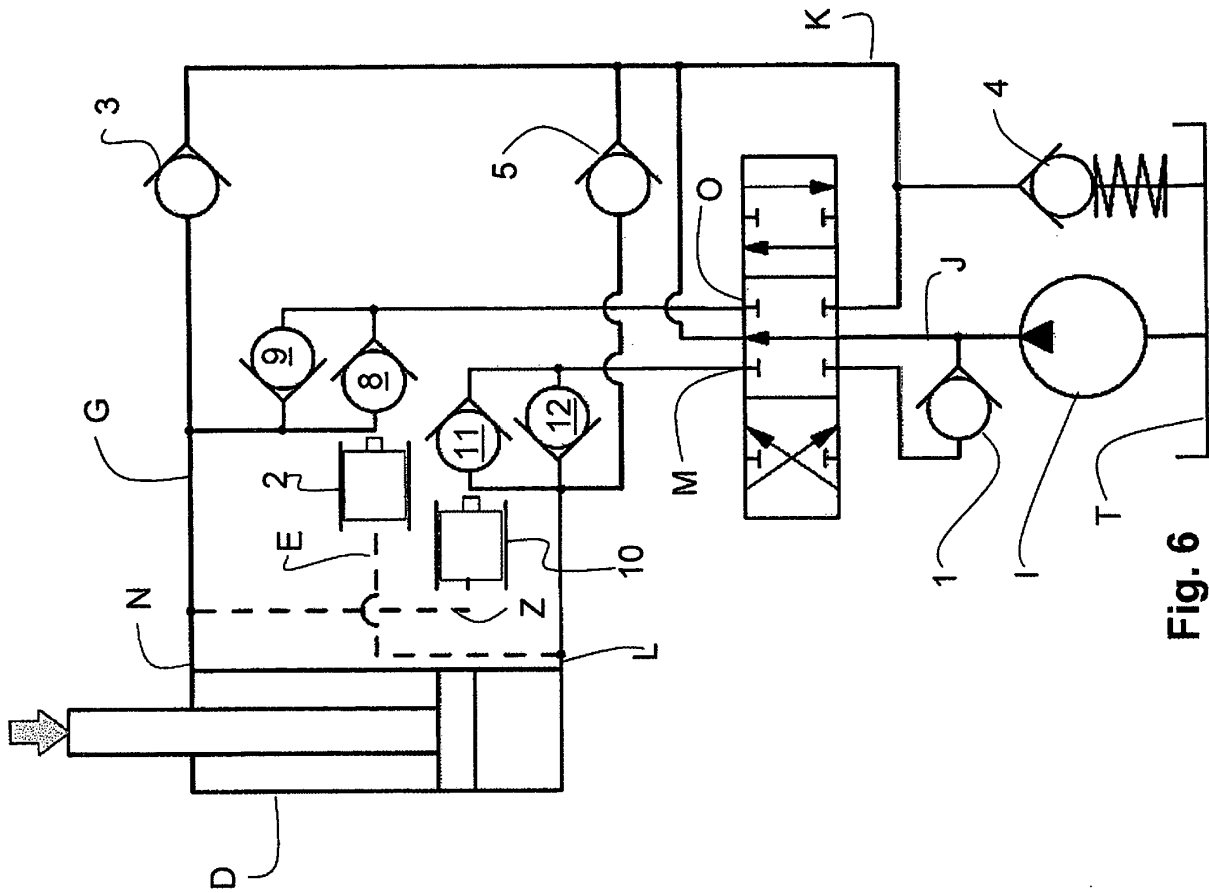


Fig. 5

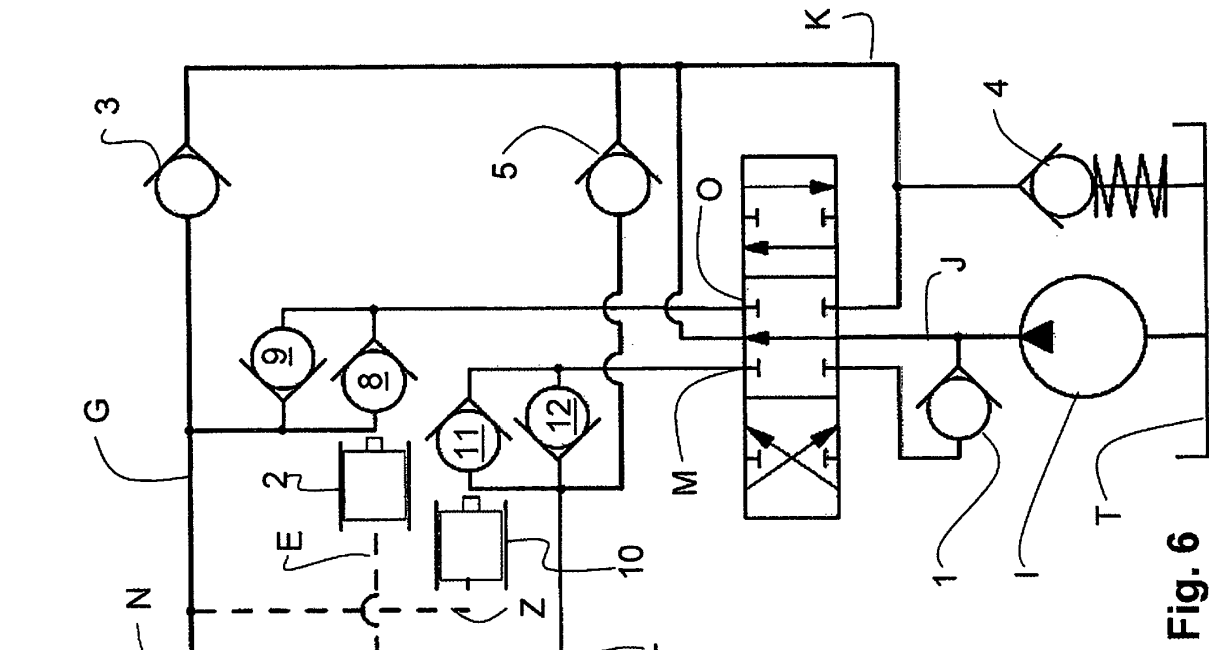


Fig. 6

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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